ROCO224 Introduction to Robotics

Coursework Assignment

Academic year 2018-2019
Assignment set by Ian Howard
This assignment counts towards 40% of your overall module mark.

Introduction

For the coursework assignment you will work on robot manipulators, both industrial arms and your own arm design. Typical skills to be acquired/demonstrated include the programming of industrial robot arms, both physical and in simulation, and the use of kinematics, CAD, 3D printing, engineering materials, mechanisms, robot programming and structural analysis.
The assignment is a group assignment, and is composed of the following parts, with associated marks indicated as a percentage:

1. Programming industrial robots (**30%** of coursework marks)
2. Design and control of manipulators (**60%** of coursework marks)

These parts correspond also to the lab sessions you will be attending during the module. You will submit a final report as a group (see more info below).
In addition, the practical component of the module includes a robot driving test on the Mitsubishi industrial robots. This accounts for **10%** of the coursework mark and is on an individual basis.

Groups

You will be divided in groups of 3-4 students each. The groups will be assigned randomly. Switching groups can only be done in pairs, one from each group, and with the consent of all members of the groups involved and should be organized by the interested student(s) during the first week of the module. **It is expected that all group members contribute across all the parts of the assignment/lab sessions, as far as is feasible.**

1. Programming industrial robots

For this part of the assignment you will be given lab sessions on programming industrial robots. During the lab sessions you are going to learn and have some practice with the Industrial robot arms (Mitsubishi RV-2AJ and RV-2SD). The industrial robots and associated software are in the SMB303B lab only. You will be provided with a student manual for this part of the assignment on the DLE, which also contains the exact task specifications.

2. Design and control of manipulators

For this part of the assignment you will be tasked with working on the design and closed-loop movement planning/control of a robot manipulator. The arms will be actuated by Hobby servos, and will be controlled via Matlab, or your own embedded microcontroller. The physical design of the robot arms can be altered, both in terms of 3D printing new links, but also in altering the joint number and configuration in the kinematic chain. You will be provided with a student manual for this part of the assignment on the DLE, which also contains the exact task specifications.
While the summative assessment for this part of the assignment is in the final report (see report structure below), there will also be a formative assessment deadline. This will be set out as a module Showcase.

Module Showcase: The module showcase is a unique opportunity to display and demonstrate your robotics project. It is an occasion where your design can be scrutinized by

other teaching staff and students, but it is also an opportunity to explain and justify your design choices and considerations. Each group is expected to provide a short 5-minute presentation/demonstration where they can show both the final project, but also include testing data from the design/hardware build. A video would be beneficial.

Report content

The report assignment should be submitted as a group, as **a single pdf document**, and should contain the following sections and suggested content (as a minimum):

1. **Programming industrial robots** (approximately 1000 words)
    - Introduction
        - Description of robot
        - Description of task
        - Description of software used
    - Relevance
        - Brief comparison of simulated and real robot
    - Development
        - Describe how you worked as a team to solve the task
        - Describe briefly problems encountered
        - Describe briefly lessons learned
    - Results
        - Show how well your solution worked
        - Show any errors in executing the task
        - Include figures with images/drawings etc.
    - Conclusion
        - Briefly conclude this part of the coursework

2. **Design and control of manipulators** (approximately 3000 words)
    - Introduction
        - Description of hardware
        - Description of task
        - An overview of your approach to the problem
    - Design Process
        - What design iterations have you gone through?
        - Who worked on what, and when?
        - What problems did you encounter, and how did you solve them?
    - Implementation
        - Describe the final implementation of your manipulator
        - Include figures with images/drawings etc.
        - Include your solutions for kinematics, motion planning etc.
        - Be brief, include support material in appendices, if need be
    - Experiments
        - What testing have you performed of the robot (or subsystems)
        - How well have you been able to perform the goal task?
        - Include a Method, Results, and Discussion sub-section for each experiment
    - Conclusion
        - Briefly conclude this part of the coursework

The report should contain extensive and well-explained figures, but also links to supplementary material supporting your project. For example, the expected way to achieve this is to set up a free GitHub repository for the project (https://github.com), where you can share code, printable files, instructions and other material that helps document your project fully. We encourage the inclusion

of data from experiments performed on the robot, and a descriptive front page/readme file. This type of repository can also enable replication by other students and researchers, and could be a valuable asset to refer to in your continuing career. Good-quality videos shared on YouTube is also encouraged and should be linked to from the report (and the repository).
Please note that you are yourself responsible for not publishing copyrighted or illegal material on such channels, and you are advised to only include content you yourself has produced.